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EFFECT OF SOWING, HARVESTING DATES AND STORAGE PERIODS ON RICE (*Oryzae sativa, L.*,) SEED VIABILITY AND SEEDLING VIGOUR

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ABSTRACT

Sowing and harvesting dates as well as storage periods have considerable influence on rice seed quality as measured by seed viability, seedling vigour, 100-seed dry weight, dehydrogenase activity, electrical conductivity, seed moisture content and field emergence. Two experiments were conducted at El-Sirw Experimental Station, Agriculture Research Center during 2002 and 2003 seasons. The main results could be summarized as follows:

Sowing rice seed in early date 25 th April reduced seed viability, seedling vigour and field emergence, while electrical conductivity and seed moisture content were increased. In contrast, sowing date 15 th May improved seed viability, seedlings vigour, 100-seed dry weight, dehydrogenase activity, field emergence and it reduced electrical conductivity and seed moisture content. Harvesting rice plant at the early date 23 day after heading reduced seed viability, seedlings vigour and field emergence but it increased electrical conductivity and seed moisture content. Harvesting date 37 day after heading improved seed viability and seedlings vigour. Increasing storage period decreased seed viability, seedlings vigour, 100-seed weight, dehydrogenase activity, seed moisture content, field emergence and increasing electrical conductivity. Positively significant correlations were found for the most studied traits and sowing dates except for negatively significant correlation with seed moisture content. Furthermore, significantly positive correlations were obtained for all the studied traits with harvesting dates. On the other hand, significantly negative correlations for seed moisture content and electrical conductivity with delaying harvesting dates. Storage periods had significantly negative correlation with the most studied traits excepting electrical conductivity while significant positive correlation was found. Meanwhile germination percentage had insignificant negative correlation. The study suggested, sowing rice (c.v. Giza 178) from (5:15 May) and harvesting 30:37 days after heading and storage until 8 months to obtain high seed viability and seedling vigour.

INTRODUCTION

Rice is the most important staple food crop of about 60% of the world population. In Egypt, rice always plays an important role in the Egyptian economy, while the per area yield ranks the highest in Egypt, and the quantity exported in 2005 around million ton proceeds around 374 million Dollars and this equal more than third Egyptians agriculture exports. Moreover, we need to increase our productivity as against reducing the cultivated area due to the fact that rice is a high water consumer crop. Raising the productivity of rice through optimizing the culture practices specially using high quality seedlings. Rice seed quality may affected by many factors among them the environmental conditions surrounded the mother plant seed production, while the temperature degree and day length are two important environmental factors that affect the development of the rice plant. High temperature lids to

prematurely accelerated ripening grain and causes imbalance situation between photosynthesis and respiration. On contrast, low temperature causes lower respiration but increases the ripping period. For photoperiod-sensitive varieties, the longer the day length the longer the growth duration, unfavorable day length may accelerate or delayed flowering as well as irregularity in flowering, resulting in uneven maturity. Meanwhile, insensitive varieties don't show any marked response to day length. Planting date has beer recognized as one of the most important factor having a pronounce effect on rice seed viability. Chopra *et al.* (2003) in India found that rice seed germination was higher than the minimum seed standard (80%) up to 21 July. However germination was blew the minimum standard on 28 July and 4 August. Also, significant reduction in seedling vigor was recorded on 21 July (18%) compared with 30 June transplanting. Ellis *et al.* (1993) and Ellis and Hong (1994), showed that Japonica cultivars produced seed with lower potential longevity when grown under (32/24 C°) than when grown under (28/20 C°). Alternating sowing dates affect seed maturation, so that, harvesting dates play important role in seed quality. Sato (1973) and Yashiida and Hara (1977) reported that the pest ripening conditions for high germinability and seedling vigour for japonica cultivars are around 20 C° day temperature and around 25 c° for India cultivars, on the other hand, Kameswara and Jackson (1996) reported that rice seed from early harvest generally had higher moisture content in the first sowing date than in the second and third sowings. Changes in germinability were similar among sowing dates. Potential longevity was obtained between 25 and 37 days after flowering. i.e. 5-14 days after mass maturity. Dewedar (2004), stated that planting rice 15 May gave the highest values of 1000-grain weight. The stage of seed maturity at harvest had insignificant effect on final germination but the mean germination time at fresh seed was shorter in seeds harvested later at full maturity, Shephard *et al.* (1995). Also Dewedar (2004) reported that harvesting rice at 37 days after heading gave the highest value of 1000-grain weight. After harvest the germination capacity or viability of seed remains constant over periods of time ranging from weeks and months. The length of time for which seed can be stored is therefore dependent on its viability and this in turn is affected by the species, its pre-storage treatment and the conditions of storage. It has been known that immature seeds lose viability faster than mature seeds under similar storage conditions (Austin, 1972 and Justice and Bass, 1978). Harrington (1972) found that developing seeds attain maximum viability and vigour at physiological maturity and those they then begin to age, with viability and vigour declining thereafter. Over viewing the previous finding it is very important to study the effect of sowing dates, harvesting dates and storage periods on rice seed viability and seedling vigour.

The aim of this study was to investigate the effect of four sowing dates, four harvesting dates and four storage periods on rice (c.v. Giza 178) seed viability, seedlings vigour and field emergence.

MATERIALS AND METHODS

Two field experiments were conducted at El-Sirw Agriculture Research Station, Damietta governorate, Egypt, during the two successive seasons of 2002 and 2003. The aim of this study was to investigate the effect of four sowing dates namely 25 April, 5, 15 th May and 25 th May and four harvesting dates i.e. 23, 30, 37 and 44 days after heading (DAH) and four storage periods e.g. 0, 4, 8 and 12 months after harvest on rice (c.v. Giza 178) seed viability, seedlings vigour and field emergence. Rice seeds were obtained from National Research Program at ARC. Rice seeds at a rate of 60 Kg/fed. were sown in prepared wet seedbed. Using split plot design with four replicates, thirty days old seedlings were transplanted in 10 m plots (10 rows x 0.2 m between rows, 5 m length). The four planting dates (25 th April, 5 th May, 15 th May and 25 th May) were arranged in the main plots and the four harvesting dates (23, 30, 37 and 44 days after heading) were allocated in the sub plots. All usual agriculture practices of growing rice were performed as recommended by Ministry of Agriculture and Land Reclamanation. After each harvesting date ten plants were taken at random of each plot to assess the studied traits. The seeds were threshed gently by hand to avoid seed injury, cleaned from dust and the unfilled grains were removed.

The studied traits were determined immediately after harvest, in the same time seeds were air dried before storage in close bags for 4, 8 and 12 months after harvesting under laboratory conditions. After each storage period, the studied traits were estimated while the germination percentage was performed according to International Seed Testing Association (ISTA, 1985). Rice seeds were sown at 25C°±2 on moist filter paper in sterilized Petri dishes and defined as the total number of normal seedlings after 10 days while, germination index was calculated according to (Alvarado *et al.*, 1987), germination rate defined according to Bartlett, (1937) meanwhile germination energy was calculated according to (Ruan *et al.*, 2002) and seedling vigour index was calculated according to (ISTA 1985). During the final count, ten normal seedlings from each replicate were taken randomly to measure the plumule and radical length in mm, after that, the seedlings were dried in hot-air oven at 85 C° for 12 hours (Krishnasamy and Seshu, 1990). Four samples of 100 seed were dried in hot air oven at 85 C for 48 h to determine 100-seed dry weight. Moisture content determinations were made on four replicates according to (ISTA.,1985). Dehydrogenase activity was measured according to Krishnasamy and Seshu (1990). Electrical conductivity was measured according to (Matthews and Alison (1987). Field emergence was recorded by seeding 400 seed from each treatment randomized block design in four replicates in the field and the normal seedlings were counted after 10 days from sowing. Data collected from these experiments were subjected to analysis of variance as randomize complete block design as mentioned by Gomez and Gomez (1984) and the treated averages were compared by using the least significant differences (LSD) method. Simple correlation's coefficient for sowing dates, harvesting date and storage period with the studied traits were computed according to Svap (1973).

Table 1: Temperature degrees and relative humidity of Damietta province during 2002 and 2003 seasons.

Months of growth	Temperature degrees C^0						Relative humidity %	
Season	2002		Mean	2003		Mean	2002	2003
	Maximum	Minimum		Maximum	Minimum			
May	28.0	14.8	21.4	30.2	13.6	16.9	73.0	73.0
June	29.0	16.3	22.7	32.3	18.4	25.4	74.0	74.0
July	31.5	20.5	26.0	34.4	21.0	27.7	73.5	73.0
August	31.5	21.2	26.4	33.6	20.3	27.5	81.7	81.7
September	33.5	24.7	29.1	34.0	19.8	26.9	79.0	79.0
October	29.0	15.8	22.4	28.9	16.0	22.5	70.0	70.0

RESULTS AND DISCUSSION

Results in Table 2, show the effect of sowing dates on the studied traits. Sowing dates had a significant effect on all the studied traits. Germination percentage reached its highest means 96.6% and 97.9% in 2002 and 2003 seasons, respectively. Meanwhile, it ranged from 95.4% and 97.1% for rice seed planted at 25th May and 96.4 and 97.85 for rice seed planted at 5 th May in both seasons. Germination index, germination rate and germination energy had the same trends while seeding rice seed in15 th May gave the highest means of these traits followed by 5 th May, 25 th May and finally the earlier seeding date 25thApril. Also seedling length, seedling dry weight and seedlings vigour index reached their highest values by seeding date 15 th May. On contrast these means were decreased gradually to the lowest value by sowing date 25 th April. Table 2 show also that 100-seed dry weight reached its heaviest weight 1.62g and 1.65 g in both seasons, respectively by sowing rice seed in 15 th May. On contrary, the means were decreased gradually to 1.32 g and 1.35 g by sowing rice seed in earlier date 25th April in both seasons, respectively. Also dehydrogenase activity has the same trends.On the other side, electrical conductivity and seed moisture content were reached lowest means at sowing date 15 th May in both seasons and its highest means at sowing date 25 th April. Means of field emergence were in the same line of seed germination and seedling vigour while the highest means were recorded at sowing date 15 th May meanwhile, the lowest means were recorded at sowing date 25 th April.

Results presented in Table 3, illustrated that the effect of harvesting dates on the studied traits in 2002 and 2003 seasons. From these results germination percentage, germination index, germination rate, germination energy, seedlings length, seedlings dry weight, seedlings vigour index, dehydrogenase activity and 100-seed dry weight reached its highest means at harvesting date after heading with 37 day. Meanwhile the lowest means of these traits were recorded from harvesting rice seed after heading with 23 days. On the other hand harvesting rice seed after heading with 37 days had the lowest means of electrical conductivity and seed moisture content.

Table 2: Effect of sowing dates on seed germination traits and seedlings vigour, 100 seed dry weight, dehydrogenase activity, electrical conductivity, seed moisture content and field emergence in 2002 and 2003 seasons.

Treatments	Germ. %	Germ .index	Germ. rate	Germ. energy	Plumule length (cm)	Radical length (cm)	Seedlings dry weight (g)	Seedlings vigour index	100-seed dry weight (g)	DHA (OD)	Electrical conductivity umohs/g seed	Seed moisture content%	Field emergence
	2002												
25 April	95.6	13.8	0.818	55.3	5.3	6.2	0.156	1108.5	1.32	0.073	0.044	18.3	74.1
5 May	96.4	14.1	0.834	58.3	5.8	6.8	0.160	1216.7	1.51	0.077	0.039	17.5	76.6
15 May	96.6	14.2	0.834	59.6	6.0	6.9	0.161	1240.4	1.62	0.079	0.038	16.7	79.2
25 may	95.4	13.8	0.822	58.2	5.8	6.8	0.159	1202.1	1.59	0.078	0.038	16.3	78.2
LSD. 5%	0.4	0.1	0.003	0.4	0.1	0.1	0.001	13.3	0.05	0.001	0.001	0.3	0.3
	2003												
25 April	97.2	14.5	0.819	56.43	5.6	6.1	0.172	1131.3	1.35	0.070	0.049	19.3	75.4
5 May	97.8	14.8	0.836	57.35	6.3	6.1	0.176	1237.6	1.54	0.073	0.045	18.4	78.0
15 May	97.9	14.9	0.835	57.79	6.2	6.6	0.177	1260.7	1.65	0.075	0.044	17.7	80.5
25 may	97.1	14.5	0.824	56.38	6.0	6.7	0.175	1227.1	1.61	0.075	0.044	17.2	79.5
LSD 5%	0.3	0.1	0.003	0.4	0.1	0.1	0.001	13.1	0.05	0.001	0.001	0.3	0.3

Table 3: Effect of harvesting dates on seed germination traits and seedlings vigour, 100 seed dry weight, dehydrogenase activity, electrical conductivity, seed moisture content and field emergence in 2002 and 2003 seasons.

Treatments	Germ. %	Germ .index	Germ. rate	Germ. energy	Plumule length (cm)	Radical length (cm)	Seedlings dry weight (g)	Seedlings vigour index	100-seed dry weight (g)	DHA (OD)	Electrical conductivity umohs/g seed	Seed moisture content%	Field emergence
	2002												
23 DAH	95.0	13.7	0.821	54.9	5.4	6.4	0.156	1113.9	1.45	0.073	0.043	18.8	76.2
30 DAH	95.8	13.9	0.825	55.7	5.7	6.7	0.158	1185.5	1.51	0.076	0.040	17.6	76.9
37 DAH	96.6	14.1	0.830	56.3	6.0	6.9	0.161	1247.7	1.56	0.080	0.038	16.4	77.5
44 DAH	96.6	14.1	0.832	56.4	5.9	6.7	0.161	1220.6	1.53	0.078	0.038	16.0	77.5
L.S.D. 5%	0.4	0.1	0.003	0.4	0.1	0.1	0.001	13.3	0.05	0.001	0.001	0.3	0.3
	2003												
23 DAH	96.7	14.4	0.823	56.09	5.6	6.2	0.172	1137.5	1.47	0.069	0.049	19.8	77.5
30 DAH	97.4	14.6	0.827	56.87	5.9	6.5	0.174	1208.3	1.54	0.073	0.045	18.5	78.2
37 DAH	97.9	14.8	0.831	57.43	6.2	6.7	0.177	1268.5	1.58	0.076	0.044	17.4	78.8
44 DAH	98.0	14.8	0.833	57.57	6.1	6.6	0.176	1242.3	1.55	0.074	0.044	16.9	78.9
LSD 5%	0.3	0.1	0.003	0.4	0.1	0.1	0.001	13.1	0.05	0.001	0.001	0.3	0.3

On contrary, rice seed harvested earlier i.e. after heading with 23 day had the highest means of electrical conductivity and seed moisture content. Data of field emergence had on the same line with the previous results while the highest means of field emergence 77.5% and 78.9% were obtained from harvesting rice plants after heading with 37 or 44 days at 2002 and 2003 seasons. On the other side the lowest means 76.2% and 77.5 % were obtained at harvesting date 23 days after heading. Data presented in Table 4

clear the effect of storage periods on the studied traits. Rice seed tested immediately after harvest had the highest values of germination percentage, germination index, germination energy, seedling length, seedling dry weight, seedling vigour index, 100-seed dry weight, dehydrogenase activity, seed moisture content and field emergence. On contrast, the lowest means of these traits were obtained after storage with 12 months. Records of electrical conductivity reached its lowest values (0.037 and 0.042 *u*mohs/g seed) direct'y after harvest in 2002 and 2003 seasons, respectively, while the highest means were obtained after 12 months from storage.

Table 4: Effect of storage periods on seed germination and seedlings vigour, 100 seed dry weight, dehydrogenase activity, electrical conductivity, seed moisture content and field emergence in 2002 and 2003 seasons.

Treatments	Germ. %	Germ .index	Germ. rate	Germ. energy	Plumule Length (cm)	Radical length (cm)	Seedlings dry weight (g)	Seedlings vigour index	100-seed dry weight (g)	DHA (OD)	Electrical conductivity umohs/g seed	Seed moisture content%	Field emergence
	2002												
0 month	97.0	14.3	0.828	57.2	5.9	6.9	0.161	1238.4	1.57	0.079	0.037	22.4	77.6
4 month	96.6	14.3	0.838	57.1	5.9	6.8	0.160	1224.0	1.53	0.077	0.038	16.2	77.3
8 month	95.9	13.7	0.820	54.7	5.7	6.9	0.158	1184.5	1.50	0.077	0.040	15.2	77.2
12 month	94.5	13.6	0.822	54.4	5.5	6.3	0.156	1120.8	1.45	0.074	0.044	15.2	76.0
LSD.5%	0.3	0.1	0.003	0.3	0.1	0.1	0.001	14.3	0.05	0.001	0.001	0.3	0.3
	2003												
0 month	98.5	15.3	0.830	58.47	6.1	6.7	0.178	1257.8	1.61	0.081	0.042	23.8	79.3
4 month	98.3	15.1	0.840	58.38	6.1	6.6	0.177	1244.6	1.56	0.079	0.041	17.3	78.7
8 month	97.8	14.2	0.821	55.67	6.0	6.5	0.175	1221.5	1.52	0.067	0.047	16.0	78.6
12 month	95.5	14.1	0.823	55.44	5.6	6.2	0.168	1132.7	1.46	0.066	0.051	15.5	76.8
LSD 5%	0.3	0.1	0.003	0.3	0.1	0.1	0.001	14.5	0.04	0.001	0.001	0.3	0.3

Interaction between sowing dates and harvesting dates had significant effects on germination percentage, germination rate, seedlings length, seedlings dry weight, seedlings vigour index, dehydrogenase activity and electrical conductivity in 2002 and 2003 seasons (Table 5). Meanwhile this interaction had insignificant effect on 100-seed dry weight after heading. Results in Table 6 show the effect of interaction between sowing dates and storage periods had a significant effects on germination percentage, germination index, germination rate, germination energy, dehydrogenase activity, electrical conductivity, seed moisture content as well as field emergence. Germinability of rice seed reached its highest means 97.8% and 98.9% in 2002 and 2003 seasons, respectively at sowing date 15 th May directly after harvesting. Meanwhile, the lowest means 93.6% and 94.65 were obtained by sowing date 25 th May after storage with 12 months. Generally, the same trends were obtained for germination index, germination rate, germination energy, dehydrogenase activity, seed moisture content and field emergence. Meanwhile, while the highest mean of electrical conductivity 24.3% and 25.4% were obtained directly after harvest from sowing date 25th April on the other side the lowest means 14.6% and 15% were obtained after 12 months from storage at sowing date 25th May.

Table 5: Effect of interaction between sowing dates and harvesting dates on germination percentage, germination rat, plumule length, radical length, seedlings dry weight, seedlings vigour index, dehydrogenase activity and electrical conductivity in 2002 and 2003 seasons.

Treatments		Germ. %		Germ. rate		Plumule length (cm)		Radical length (cm)		Seedlings dry weight (g)		Seedlings vigour index	Dehydrogenase activity (OD)		Electrical conductivity umohs/g seed	
Sowing dates	Harvesting dates	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2002	2003	2002	2003
25 April	23 DAH	93.9	95.7	0.807	0.808	4.9	5.1	5.8	5.6	0.151	0.167	999.6	0.070	0.066	0.047	0.053
	30 DAH	95.3	97.0	0.816	0.817	5.2	5.4	6.1	5.9	0.154	0.170	1076.7	0.073	0.070	0.045	0.051
	37 DAH	96.6	98.2	0.825	0.827	5.7	5.9	6.6	6.4	0.160	0.176	1185.3	0.075	0.072	0.042	0.047
	44 DAH	96.5	98.0	0.824	0.825	5.7	5.9	6.5	6.3	0.159	0.175	1172.5	0.074	0.071	0.042	0.047
5 May	23 DAH	95.7	97.4	0.831	0.832	5.5	5.7	6.5	6.4	0.157	0.173	1151.2	0.073	0.069	0.043	0.049
	30 DAH	96.3	97.7	0.833	0.834	5.8	5.6	6.8	6.6	0.159	0.175	1208.4	0.077	0.074	0.039	0.044
	37 DAH	96.7	97.7	0.834	0.835	6.1	6.3	7.0	6.8	0.163	0.178	1262.0	0.081	0.077	0.037	0.042
	44 DAH	96.9	98.3	0.839	0.841	6.0	6.2	6.9	6.7	0.161	0.177	1245.1	0.076	0.072	0.038	0.043
15 May	23 DAH	95.6	97.2	0.831	0.833	5.6	5.8	6.7	6.5	0.158	0.174	1168.6	0.075	0.072	0.043	0.049
	30 DAH	96.9	98.2	0.834	0.836	6.0	6.2	7.0	6.8	0.160	0.176	1252.3	0.078	0.075	0.037	0.043
	37 DAH	97.1	98.3	0.835	0.837	6.2	6.4	7.1	6.9	0.163	0.179	1293.6	0.082	0.079	0.036	0.041
	44 DAH	97.0	98.1	0.834	0.835	6.1	6.3	7.8	6.6	0.163	0.179	1247.2	0.080	0.077	0.036	0.041
25 May	23 DAH	94.6	96.4	0.817	0.818	5.5	5.7	6.5	6.3	0.157	0.173	1136.1	0.074	0.071	0.039	0.045
	30 DAH	94.8	96.6	0.818	0.819	5.9	6.1	6.8	6.7	0.160	0.176	1204.7	0.077	0.074	0.039	0.044
	37 DAH	95.9	97.5	0.824	0.826	6.1	6.3	7.0	6.8	0.160	0.176	1250.1	0.081	0.077	0.038	0.043
	44 DAH	96.1	97.8	0.830	0.831	5.8	6.0	6.9	6.7	0.159	0.175	1217.7	0.081	0.077	0.037	0.042
LSD 5 %		0.8	0.6	0.008	0.008	0.2	0.2	0.3	3	0.002	0.002	30.0	0.002	0.002	0.002	0.002

Table 6: Effect of interaction between sowing dates and storage on germination percentage, germination index, germination rate, germination energy, dehydrogenase activity, electrical conductivity, seed moisture content and field emergence in 2002 and 2003 seasons...

Treatments		Germ. %		Germ .index		Germ. rate		Germ. Energy		Dehydrogenase activity (OD)		Electrical conductivity umohs/g seed		Seed moisture content%		Field emergence	
Sowing dates	Storage periods	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003	2002	2003
25April	0 month	95.9	97.9	14.0	15.0	0.818	0.820	56.1	58.1	0.075	0.077	0.040	0.045	24.3	25.7	73.9	75.6
	4 month	96.0	97.8	14.1	14.9	0.823	0.825	56.3	57.6	0.074	0.076	0.042	0.045	17.2	18.3	73.9	75.4
	8 month	95.8	97.7	13.6	14.1	0.807	0.808	54.4	55.4	0.072	0.062	0.045	0.051	16.2	17.0	74.7	76.2
	12 month	94.5	95.5	13.6	14.1	0.823	0.824	54.4	55.4	0.070	0.062	0.050	0.057	15.7	16.2	73.7	74.5
5 May	0 month	97.6	98.8	14.1	15.4	0.836	0.838	57.6	58.9	0.078	0.080	0.036	0.041	22.6	24.1	77.1	78.8
	4 month	97.2	98.7	14.4	15.2	0.848	0.850	57.7	59.0	0.077	0.079	0.038	0.041	17.1	18.2	76.8	78.2
	8 month	95.9	97.9	13.7	14.2	0.827	0.828	54.8	55.8	0.076	0.066	0.040	0.047	15.1	15.9	76.8	78.2
	12 month	94.8	95.8	13.7	14.2	0.825	0.826	54.8	55.8	0.075	0.067	0.044	0.050	15.1	15.6	75.8	76.6
15 May	0 month	97.8	98.9	14.6	15.6	0.840	0.842	58.4	59.7	0.081	0.083	0.035	0.040	21.8	23.2	80.2	81.9
	4 month	97.3	98.6	14.5	15.3	0.843	0.845	57.9	59.2	0.079	0.081	0.036	0.039	15.4	16.6	79.7	81.2
	8 month	96.5	98.3	13.8	14.3	0.825	0.826	55.3	56.3	0.079	0.069	0.038	0.045	15.0	15.8	79.1	80.6
	12 month	95.0	96.0	13.8	14.3	0.826	0.827	55.0	56.0	0.077	0.069	0.044	0.051	14.8	15.2	77.9	78.7
25 May	0 month	96.5	98.4	14.2	15.2	0.818	0.820	56.6	57.9	0.080	0.082	0.035	0.040	20.7	22.1	79.1	80.8
	4 month	96.1	97.9	14.6	14.9	0.837	0.839	56.4	57.7	0.078	0.080	0.037	0.040	15.1	16.2	78.8	80.2
	8 month	95.3	97.3	13.6	14.1	0.819	0.820	54.3	55.3	0.079	0.069	0.040	0.046	14.7	15.5	78.1	79.5
	12 month	93.6	94.6	13.4	13.9	0.814	0.815	53.6	54.6	0.075	0.066	0.041	0.048	14.6	15.1	76.8	77.6
LSD 5%		0.6	0.5	0.2	0.2	0.006	0.006	0.7	0.7	0.001	0.001	0.001	0.001	0.62	0.60	0.5	0.5

On the other side, insignificant effects for this interaction on the other traits were noticed. Interaction between harvesting date and storage periods had significant effects on germination percentage in 2002 season, germination energy, dehydrogenase activity, electrical conductivity and seed moisture content in 2002 and 2003 seasons (Table 7). While the highest means of germination percentage 98.8%, germination energy 57.6 and 58.9 dehydrogenase activity 0.081 and 0.083 were obtained directly after harvest from harvesting date 37 days after heading, meanwhile the highest means of seed moisture content 25.2% and 26.6% were obtained directly after the first harvesting date. On contrast the lowest means 14.5% and 14.9% were obtained from rice plants harvested after heading with 44 days after 12 months from storage. The lowest values of electrical conductivity were obtained directly after harvest from the third harvesting date (37 days) on contrast, the highest values 0.049 and 0.056 *u*mohs/g seed were obtained from rice seed harvested after heading with 23 days when stored for 12 months.

Table 7: Effect of interaction between harvesting dates and storage periods on germination percentage, germination energy, electrical conductivity and seed moisture content in 2002 and 2003 seasons.

Treatments		Germ. %	Germ. energy		Dehydrogenase activity (OD)		Electrical conductivity *u*mohs/g seed		Seed moisture content%	
Harvesting dates	Storage periods	2002	2002	2003	2002	2003	2002	2003	2002	2003
23 DAH	0 month	98.1	56.8	58.1	0.076	0.078	0.039	0.044	25.2	26.6
	4 month	97.6	55.9	57.2	0.074	0.076	0.041	0.044	17.5	18.7
	8 month	96.6	53.8	54.8	0.072	0.062	0.045	0.051	16.5	17.3
	12 month	94.3	53.3	54.3	0.070	0.062	0.049	0.056	16.1	16.6
30 DAH	0 month	98.4	56.9	58.2	0.078	0.080	0.037	0.042	23.7	25.2
	4 month	98.3	57.5	58.8	0.077	0.079	0.038	0.041	16.4	17.5
	8 month	97.5	54.3	55.3	0.076	0.066	0.041	0.048	15.3	16.1
	12 month	95.2	54.2	55.2	0.075	0.066	0.044	0.051	15.0	15.5
37 DAH	0 month	98.6	57.6	58.9	0.081	0.083	0.036	0.041	21.1	22.5
	4 month	98.6	57.5	58.8	0.080	0.082	0.036	0.039	15.5	16.6
	8 month	98.5	55.2	56.2	0.079	0.069	0.038	0.045	14.6	15.4
	12 month	95.9	54.9	55.9	0.078	0.070	0.042	0.049	14.6	15.1
44 DAH	0 month	98.8	57.4	58.7	0.079	0.081	0.035	0.040	19.5	20.9
	4 month	98.6	57.4	58.7	0.078	0.080	0.036	0.039	15.4	16.5
	8 month	98.4	55.4	56.4	0.079	0.069	0.038	0.045	14.6	15.4
	12 month	96.4	55.4	56.4	0.075	0.067	0.043	0.050	14.5	14.9
LSD 5%		0.5	0.7	0.7	0.001	0.001	0.001	0.001	0.62	0.62

This interaction had insignificant effects on the other traits. Correlation studies between the studied traits and sowing dates, harvesting dates and storage periods are presented in Table (8). The correlation studies revealed that their were positively and significantly correlations for germination rate (r =0.096), plumule length (r=0.371), radical length (r=0.409), seedlings dry weight (r=0.116), Dehydrogenase activity (r=0.296), 100-seed dry weight (r=0.537), seedlings vigour index (r=0.361) and field emergence (r=0.695) with sowing dates meanwhile, seed moisture content (r=-0.214) and electrical

conductivity (r=-0.340) were found to be negatively and significantly correlated with sowing dates. On the other side, germination percentage was negatively and insignificantly correlated with sowing dates but germination index and germination energy were positively and insignificantly correlated with sowing dates. Significantly positive correlations were noticed for germination percentage (r=0.325), germination index (r=0.219), germination rate (r=0.271), germination energy (r=0.280), plumule length (r=0.465), radical length (r=0.325), seedlings dry weight (r=0.210), seedlings vigour index (r=0.444), Dehydrogenase activity (r=0.300), 100-seed dry weight (r=0.169) and field emergence (r=0.212). On the other side, their were significantly negative correlation for seed moisture content (r=-0.299) and electrical conductivity (r=-0.317) with harvesting dates. Storage periods had significantly negative correlation with the most studied traits except electrical conductivity while significant positive correlation was found. Meanwhile germination percentage had insignificant positive correlation with storage periods. From these results it can noticed that, seeding rice seed in the earlier dates 25 th April might be incur to the adverse weather conditions such as low temperature degrees resulted in a decrease of dry matter accumulation and translocated to the seed led to decrease in seed weight consequently seed dry weight, germination percentage, seed vigour, seedlings vigour, seedlings vigour index and field emergence.

Table 8: Simple correlation of sowing dates, harvesting dates and storage periods with the studied traits.

Treatments	Sowing dates	Harvesting dates	Storage periods
Germination percentage	-0.020^{Ns}	0.325**	-0.554^{Ns}
Germination index	0.014^{Ns}	0.219**	-0.610**
Germination rate	0.096*	0.271**	-0.290**
Germination energy	0.017^{Ns}	0.280**	-0.627**
Plumule length	0.371**	0.465**	-0.343**
Radical length	0.409**	0.325**	-0.371**
Seedlings dry weight	0.116**	0.210**	-0.290**
Seedlings vigour index	0.361**	0.444**	-0.464**
100-seed dry weight	0.537**	0.169**	-0.260**
Dehydrogenase activity	0.296**	0.300**	-0.588**
Electrical conductivity	-0.340**	-0.317**	0.565**
Seed moisture content	-0.214**	-0.299**	-0.748**
Field emergence	0.695**	0.212**	-0.230**

On the other side we noticed that, seed moisture content was higher than late sowing dates. On the other hand, the increase in seed dry weight and seedling vigour were increase piecemial until its maximum means at sowing date 15 th May, while this might refer to this planting date had the best weather condition which led to corresponding the increase effect on he amount of dry matter translocated and stored in seeds as well as 100-seed dry weight at the trim of the late planting date while short day length, short growth duration and low temperature during repining. With regard to alternating harvesting dates harvesting at earlier date 23 day after heading,

the period from heading to harvesting is not enough to give most of the seed opportunity to reach full ripping thus seed moisture content percentage was higher than the other harvesting dates on contrast 100-seed dry weight was slight another dates. Harvesting rice seed at 37 day after heading was the best date to harvest rice seed while the period from heading to harvesting was enough to gave the enhance to the assimilated materials to translocated and stored dry matter into seed which led to the increase in seed dry weight as well as seed and seedlings vigour.

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تأثير مواعيدالزراعة والحصاد و فترات التخزين على حيوية وجودة بذور وقـوة بادرات الأرز.

إبراهيم فتحي مرسال

قسم بحوث تكنولوجيا البذور- معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية- مصر.

يعتبر كل من ميعاد الزراعة والحصاد وفترات التخزين من العوامل المؤثرة على جودة تقاوي الأرز و تم قياسها عن طريق صفات حيوية التقاوي وقوه البادرات، الوزن الجاف ل ١٠٠ بذرة، نشاط إنزيم الديهيدروجينيز، درجة التوصيل الكهربي، النسبة المئوية للرطوبة بالبذور و نسبة الإنبات فى الحقل للبذور. أجريت تجربتين حقليتين بمحطة البحوث الزراعية ــ بالسرو محافظة دمياط مركز البحوث الزراعية خلال موسمي ٢٠٠٢ و٢٠٠٣ م وذلك بهدف دراسة تأثير مواعيد الزراعة ٢٥ إبريل ، ٥، ١٥ و ٢٥ مايو و مواعيد الحصاد المختلفة ٢٣، ٣٠، ٣٧و٤٤ يوم بعد الطرد وفترات التخزين المختلفة صفر، ٤، ٨ و١٢ شهر بعد الحصاد على حيوية وقوة بادرات بذور الأرز صنف جيزة ١٧٨. ويمكن تلخيص أهم النتائج كما يلي:-

أدت الزراعة في الميعاد المبكر ٢٥ إبريل إلى التناقص فى صفات حيوية وقوة البادرات و نسبة الإنبات فى الحقل فيما عدا زيادة النسبة المئوية للرطوبة بالبذور، درجة التوصيل الكهربي للبذور. وعلى العكس من ذلك فقد أعطت البذور الناتجة من ميعاد الزراعة في ١٥ مايو أعلى متوسطات لنسبة الإنبات وقوة البادرات ، الوزن الجاف لل١٠٠ بذرة، نشاط إنزيم الديهيدروجينيز و نسبة الإنبات فى الحقل وأقل متوسط لدرجة التوصيل الكهربي و النسبة المئوية للرطوبة بالبذور. أدى الحصاد فى الميعاد المبكر ٢٣ يوم بعد الطرد إلى التناقص فى نسبة الإنبات في المعمل وقوة البادرات و نسبة الإنبات فى الحقل و زيادة درجة التوصيل الكهربي والنسبة المئوية للرطوبة بالبذور. و أدى تأخير ميعاد الحصاد إلى زيادة تدريجية فى حيوية البذور وقوة البادرات ووصلت إلى أعلى متوسطاتها بعد ٣٧ يوم من الطرد ثم بدأت فى التناقص. بزيادة فترات التخزين بعد الحصاد مباشرة إلى ٤أشهر ، ٨ أشهر و ١٢ شهرا بعد الحصاد إلى تناقص نسبة الإنبات ، وقوة البادرات ، نشاط إنزيم الديهيدروجينيز ، الوزن الجاف لل١٠٠ بذرة و نسبة الإنبات فى الحقل و النسبة المئوية للرطوبة بالبذور وزيادة درجة التوصيل الكهربي.

أوضحت النتائج وجود ارتباط معنوي موجب بين مواعيد الزراعة وجميع الصفات فيما عدا نسبة الإنبات حيث وجد ارتباط غير معنوي سالب وموجب مع دليل الإنبات وطاقة الإنبات كما وجد ارتباط معنوي سالب مع درجة التوصيل الكهربي ونسبة الرطوبة بالبذور. كما وجد من الدراسة ارتباط معنوي موجب بين مواعيد الحصاد ومعظم الصفات المدروسة فيما عدا درجة التوصيل الكهربي و نسبة الرطوبة بالبذور حيث وجد ارتباط معنوي سالب. وتبين الدراسة وجود ارتباط معنوي سالب بين فترات التخزين وجميع الصفات المدروسة فيما عدا درجة التوصيل الكهربي للبذور حيث وجد ارتباط معنوي موجب. وعموما توصى الدراسة بإمكانية زراعة الأرز صنف ١٧٨ ابتداء من (٥ إلى ١٥ مايو) وحصادة بعد ٣٠ إلى ٣٧ يوم من الطرد و تخزينة تحت ظروف المعمل لمدة قد تصل إلى ثمانية أشهر للحصول على بذور عالية الحيوية وقوه البادرات.